

Gulfco remedy notes:

**FROM ROD:** **The Selected Remedy** for the Site is Alternative 2 (Ground Water Controls and Monitoring). The estimated present worth cost is \$230,000. The components of this alternative are described in detail in Section 19.0 (Selected Remedy) of this ROD. The major components of this alternative are:

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1. **Review and evaluation of the current restrictive covenants** prohibiting ground water use at the Site and requiring commercial/industrial land use at the Site, and protection against indoor vapor intrusion for building construction on Lots **55, 56, and 57**;
2. **Modification of the existing Institutional Controls (ICs)** to: address any issues identified with the current restrictive covenants after review; **identify the type and location of hazardous substances**; **identify the location of the existing cap** and **restrict actions that might affect the integrity of the cap**; and any other necessary modifications; **These modifications may include the addition of supplemental information regarding the type and location of hazardous substances at the Site, including the contamination in the ground water plume, such as a metes and bounds description of the affected area and a list of the contaminants present, clarification of all use restrictions in accordance with the RA. The existing ICs also will be modified and/or supplemented to identify the location of the existing Site cap and restrict actions that might affect the integrity of the cap.**

**From responsiveness summary: Therefore, buildings can be constructed in the area north of Marlin Avenue with the EPA's approval and if the buildings have appropriate provisions to mitigate vapor intrusion.**

3. A cap over the former surface impoundments;
4. **Annual ground water monitoring**, and monitoring as a part of the Five-Year Reviews, to confirm stability of the affected ground water plume; **both in terms of lateral extent and the absence of impacts above screening levels to underlying GWBUs, will be achieved under the ground water monitoring component of Alternative 2. The monitoring component will also address the RAO of preventing human exposure to VOCs in any future buildings at levels posing an unacceptable risk for commercial/industrial workers via the ground water to indoor air pathway. The stability of the affected ground water plume will be verified by an evaluation of the temporal trends of the primary ground water COIs above their respective extent evaluation criteria in perimeter monitoring wells** using a Mann-Kendall test or similar statistical trend analysis. The EPA's guidance document titled, "Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Unified Guidance" (March 2009, USEPA Office of Resource Conservation and Recovery, EPA 530-R-09-007) will be used in this evaluation. The ground water COIs include **1,1,1 -TCA; 1,1 -DCE; 1,2,3-TCP; 1,2-DCA; benzene; cis-1,2-DCE; methylene chloride; PCE; TCE; and vinyl chloride.** For the purposes of this evaluation. Zones A and B perimeter monitoring wells will be selected as part of the Operation and Maintenance Plan. Should such trend analysis indicate a statistically significant increase (SSI), additional sampling will be performed at the indicated location within 30 days of determination of the SSI to confirm the trend. Should a confirmed SSI be indicated, then an evaluation of possible plume expansion will be performed by the installation of

one or more additional monitoring wells outward from the affected well (or wells), as necessary, to define the plume boundaries.

From FS: The **Zone A monitoring well network** will include wells **ND2MW01, ND3MW02, ND3MW29, ND4MW03, NE1MW04, NE3MW05, NF2MW06, OMW20, and OMW21.**

The **Zone B monitoring well network** will include **ND4MW24B; NE3MW30B, NE4MW31B, NG3MW25B, and OMW27B.**

The **Zone C monitoring well** will be **NE4MW32C.**

5. **Implementation of an Operation and Maintenance Plan to provide ground water monitoring and inspection/repair of the cap** covering the former surface impoundments. **The cap will be maintained and repaired to insure its continued effectiveness in preventing water infiltration and exposure to materials underlying the cap.**

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**Estimated Cost: \$230,000 (for Alternative 2 – the selected remedy)**

**These RAO objectives are:**

- 1) to **prevent further migration of the VOC and SVOC plumes in Zones A and B**, both in terms of lateral extent and the absence of impacts above screening levels to underlying ground-water units; If, in the future, the VOC and SVOC **plumes in Zones A and B do become more mobile, this will be identified through the monitoring and could be addressed by additional response actions, if necessary.**
- 2) **to prevent human exposure to VOCs in any future buildings** at levels posing an unacceptable risk for commercial/industrial workers via the ground water to indoor air pathway;
- 3) **to prevent land use other than commercial or industrial;**
- 4) to **prevent ground water use;** and
- 5) **to prevent potential future exposure to remaining waste material in the former surface impoundments.**

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Ground water in **Zones A and B** within the North Area near the former surface impoundments contains elevated concentrations of a number of VOCs, including

**1,1,1-trichloroethane (1,1,1-TCA);**  
**1,1-dichloroethene (1,1-DCE);**  
**1,2,3-trichloropropane (1,2,3-TCP);**

1,2-dichloroethane (1,2-DCA);  
benzene;  
cis-1,2-dichloroethene (cis-1,2-DCE);  
methylene chloride;  
tetrachloroethene (PCE);  
trichloroethene (TCE); and  
vinyl chloride (VC).

These VOCs are collectively referred to as the primary ground water COIs.

The ground water pathway for potential transport of primary ground water COIs or other PCOCs is lateral migration within Zones A and B and vertical migration, possibly as NAPL in very localized areas, or in dissolved form from Zone A to Zone B in areas where the clay separating Zone A and Zone B pinches out or is of minimal thickness. Vertical migration to deeper water-bearing zones below Zone B is effectively precluded by the thick and low vertical hydraulic conductivity ( $7 \times 10^{-9}$  cm/sec) clay layer below Zone B.

**Zone A** is the uppermost water-bearing unit at the Site. It is generally first encountered at a depth of 5.0 to 15.0 ft bgs, with an average depth of approximately 10.0 ft bgs, Zone A ranges in thickness from approximately 2.0 to 10.0 ft, with an average thickness of approximately 8.0 ft. Zone A consists of a heterogeneous mixture of poorly graded sand to silty sandy clay with typically a high percentage of fine-grained material. The heterogeneous and fine-grained nature of Zone A is typical of overbank flood deposits. Zone A was present in all the borings drilled at the Site. As shown on Figure 28 (Zone A Thickness Map), Zone A is generally thicker in the central areas of the Site. With a couple of exceptions (SA4PZ07 and SJ1MW15), Zone A appears to become thinner towards the west and east portions of the Site.

Ground water in Zone A predominantly occurs under confined conditions as indicated by water level elevations in Zone A monitoring wells/piezometers above the top of the unit. The Zone A potentiometric surface was evaluated through six water-level measurement events performed between October 2006 and June 2008 (Figures 22 through 27). Overall, the Zone A potentiometric surface is relatively flat. The potentiometric maps generally show a ground water divide near the center of the Site (typically in the North Area). The ground water flow direction is typically towards the west or northwest in the area north of the divide, and generally flow is to the south and southwest to the south of the divide.

Slug tests were performed on three Zone A monitoring wells to estimate the hydraulic conductivity of this zone. Estimated Zone A hydraulic conductivities ranged from  $4 \times 10^{-5}$  cm/sec to  $8 \times 10^{-5}$  cm/sec, which are within the range of typical values for a silt to silty sand. Based on these estimated hydraulic conductivities and a ground water gradient of 0.001 ft/ft to 0.02 ft/ft, the specific discharge of Zone A ranges from about  $4 \times 10^{-8}$  cm/sec to  $2 \times 10^{-6}$  cm/sec (0.04 ft/year to 2 ft/year). Dividing this range by a typical porosity of 0.4 for silt yields an average linear ground water velocity of 0.1 ft/year to 5.0 ft/year, a relatively low hydraulic conductivity.

It is likely that Zone A intersects the Intracoastal Waterway in areas adjacent to the Site. In the areas where this intersection occurs, the ground water/surface water discharge relationship likely shows both short- and long-term variations depending on Zone A potentiometric levels and the tidal stage of the waterway

Zone B is separated from Zone A by a medium- to high-plasticity clay (Unit II on Figure 30 [Idealized Site Hydrostratigraphic Column]) that typically ranges in thickness from about 2.0 to 7.0 ft. This confining unit pinches out in the southeastern part of the Site, as indicated by its absence at monitoring well SL8MW17.

**Zone B** is first encountered at a depth of 15.0 to 33.0 ft bgs. The average depth to the top of Zone B was approximately 19.0 ft bgs. Zone B is separated from Zone A by a medium- to high-plasticity clay that ranged in thickness from approximately 2.0 to 7.0 ft. Where present, Zone B sands ranged in thickness from as little as 1.0 ft to as much as approximately 20.0 ft, with an average thickness of approximately 11 ft.

Zone B is a silty to well-graded sand. As shown on Figure 31 (Zone B Thickness Map), Zone B is thickest near monitoring well NE4MW3 IB and thins to the northwest and west where it eventually pinches out. Zone B was not encountered in boring NC2B23B in the western part of the North Area and was very thin (0.2 ft thick) in boring OB26B north of the Site. Similarly, the Zone B base elevation is highest in the western part of the Site (Figure 32 [Structure Contour Map - Base of Zone B]) where it is at its thinnest. The base of Zone B generally dips to the east, with the lowest base elevation observed at Well NE4MW32C where the greatest thickness of the zone was also encountered.

Ground water in Zone B also occurs under confined conditions. The Zone B potentiometric surface was evaluated through five water-level measurement events performed between June 2007 and July 2008 (Figures 33 through 37). Data from the first water-level measurement events (June 6 and September 6, 2007 as shown on Figures 33 and 34, respectively), indicate an easterly ground water flow direction. The hydraulic gradient for these events was approximately 0.0006 ft/ft to 0.0009 ft/ft. Data from the three subsequent events (November 7, 2007; December 3, 2007; and July 30, 2008, as shown on Figures 35, 36, and 37, respectively) showed a general flow direction to the northwest. The hydraulic gradient for these events ranged from approximately 0.001 ft/ft to 0.006 ft/ft.

Slug tests were performed on three Zone B monitoring wells to estimate the hydraulic conductivity of this zone. Estimated hydraulic conductivities ranged from  $2 \times 10^{-5}$  cm/sec to  $5 \times 10^{-4}$  cm/sec, which is typical of silty sand. Based on an overall ground water gradient of 0.003 ft/ft and a hydraulic conductivity of  $1 \times 10^{-4}$  cm/sec, the average specific discharge for Zone B is estimated at about  $3 \times 10^{-7}$  cm/sec (0.3 ft/year). Dividing this average by a typical porosity of 0.4 for sand yields an average linear ground water velocity of 0.8 ft/year.

The vertical hydraulic gradient between Zones A and B was evaluated through a comparison of water elevations at three sets of paired wells screened in these units during five monitoring events. In all but two instances, an upward gradient from Zone B to Zone A was indicated. The magnitude of these upward gradients ranged from 0.02 ft/ft to 0.15 ft/ft. The two observed downward gradients (both for the ND4MW03/ ND4MW24B pair) were 0.02 ft/ft.

**Zone C** consisted of a thin, less than 0.5 ft thick, shell layer at a depth of approximately 73.0 ft bgs within a high plasticity clay unit. Approximately 25.0 ft to 50 ft of clay to silty clay separate Zone C from Zone B, where Zone B is present.

The vertical hydraulic conductivity of this clay (between B & C) is extremely low, ranging from  $5.7 \times 10^{-9}$  to  $6.6 \times 10^{-9}$  cm/sec. Due to the significant thickness (greater than 25.0 ft) and the low hydraulic conductivity of the Unit III clay separating Zones B and C, ground water communication/flow between these zones is highly unlikely.

Figures 38 through 41 depict the Zone C potentiometric surface for four water-level measurement events between June 2008 and January 2009. The four potentiometric surface maps suggest a generally **northwest ground water gradient** within Zone C. A **ground water divide** in the general area of NE4MW32C appears to be present during the September 29, 2008, and January 13, 2009, events (Figures 40 and 41, respectively). The magnitude of the Zone C hydraulic gradient appears relatively uniform across the North Area, typically in the range of 0.005 ft/ft to 0.008 ft/ft.

Vertical hydraulic gradients between Zones B and C were evaluated through comparison of water-level elevations of three pairs of wells screened in these two units for two monitoring events. A downward gradient from Zone B to Zone C was indicated in all well pairs for all of the monitoring events. The magnitude of these downward gradients ranged from 0.13 ft/ft to 0.21 ft/ft. Even though a downward vertical hydraulic gradient exists from Zone B to Zone C, there is likely little to no hydraulic communication between the two units. More than 25.0 feet of high plasticity clay with a very low vertical hydraulic conductivity of  $6 \times 10^{-9}$  to  $7 \times 10^{-9}$  cm/sec separates these two zones.

Ground water within Zone A has high natural salinity. Total Dissolved Solids (TDS) concentrations in Zone A ground water samples ranged from 29,900 mg/L to 39,800 mg/L with an average value of 34,850 mg/L. According to the EPA's ground water classification system, water with a TDS concentration greater than 10,000 mg/L is defined as non-potable. Likewise, the TCEQ, at 30 Texas Administrative Code 350.52, defines ground water with a TDS concentration that is greater than 10,000 mg/L as Class 3 ground water, which is not considered usable as drinking water.

Ground water within Zone B also has high natural salinity as indicated by a TDS concentration of 34,500 mg/L in a sample from a monitoring well. Like Zone A, ground water in Zone B has not been used as a drinking water source in the vicinity of the Site due to the high natural salinity and is not considered potable. Ground water in Zone C also has high natural salinity. The TDS concentration of a sample from a monitoring well was 24,600 mg/L, above Class 3 and potability criteria.

**Zone A:** In addition to the **10 VOCs**, Several SVOCs (i.e., **primarily anthracene, naphthalene, phenanthrene, and pyrene**) and pesticides (i.e., primarily ~~endosulfan-II~~, ~~endosulfan-sulfate~~, 4,4'-DDE, Dieldrin, **gamma-BHC**, and ~~heptachlor-epoxide~~) were occasionally detected in Zone A ground water samples at concentrations exceeding screening values (Table 20). These exceedances were either: (1) not confirmed by a second sample collected at that location (e.g., the endosulfan sulfate and heptachlor epoxide exceedances in the August 2, 2006 sample from SJ1MW15 were not confirmed in a subsequent sample collected from this well on June 4, 2007); (2) not confirmed by a sample from a monitoring well subsequently installed adjacent to a temporary piezometer location (e.g., the endosulfan II exceedance at NB4PZ01 was not confirmed by the sample from monitoring well NB4MW18); or (3) bounded by samples from downgradient monitoring wells that did not show exceedances of that specific COI (e.g., **gamma-BHC** exceedances at SF5MW10 were bounded by samples from SE6MW09, SF6MW11, and SG2MW13).

**Zone B:** As indicated in this table, the only detected concentrations exceeding screening values were seven VOCs in the sample collected from well NE3MW30B, southeast of the former surface impoundments. Ground water concentrations of several COIs in well NE3MW30B exceeded the 1%

compound solubility limit threshold indicating the possible presence of NAPL. For example, the **1,1,1-TCA** ground water concentration of 64.0 mg/L is approximately 1.5% of its solubility (4,400 mg/L), the **PCE** ground water concentration of 23.8 mg/L is approximately 16% of its solubility (150.0 mg/L), and the **TCE** concentration of 170.0 mg/L is approximately 15% of its solubility (1,100 mg/L). These ground water data support the observation of visible NAPL within the soil matrix at the base of Zone B in the soil core for NE3MW30B; however, no NAPL was observed in the ground water samples from this well. The lateral extent of contamination in Zone B is limited to NE3MW30B since there were no exceedances in samples from the other Zone B monitoring wells.

**RISK:** None of the HIs for the soil exposure pathways exceeded EPA's target hazard index of 1. Exposure from the vapor intrusion pathway from PCOCs in ground water for a hypothetical industrial worker employed in a building sited at the North Area resulted in an HI greater than 1, as shown in Table 44 (Johnson and Ettinger Vapor Intrusion Model Output for North Area Ground Water). Potential **cancer risks in the North Area were predicted to be  $2.0 \times 10^{-2}$** , which is 200 times greater than the EPA's risk level of  $1.0 \times 10^{-4}$ .